the motion of *Procyon* by Dr. Auwers gives the following results:—

Epoch of Minimum R.A.	1795·629 ± 0·675 years
Annual Motion	$9^\circ{\cdot}02993 \pm 0^\circ{\cdot}11966$
Periodic Time	39·866 ± 0·528 years
Radius of Orbit	$0''{\cdot}9805 \pm 0''{\cdot}0375$

On a remarkable Nebulous Spot observed upon the Sun's Disc by Pastorff, May 26th, 1828. By A. Cowper Ranyard, Esq.

In the first volume of the MS. Observations of Geheimerath Pastorff, which were presented to the Astronomical Society by Sir John Herschel, is a drawing of a dusky spot, with a bright nucleus, seen upon the Sun's disc, on the 26th of June, 1819, and which has been generally believed to have been the comet of 1819, as seen projected upon the bright background of the photosphere. The object of the following note is to draw the attention of the Society to a very similar nebulous spot, with a small bright centre, depicted upon a drawing of the Sun's disc for the 26th of May, 1828. It is marked by Pastorff as "Hell glänzender Fleck" (bright shining spot), and its distance parallel to the horizon from the nearest point of the Sun's western limb is given as 3′; the observation was made at half-past nine in the morning, at Buchholz,* near Drossen. On the drawings of the Sun's disc for the preceding and succeeding days no such spot is registered, nor is any sun-spot or facula given as in or near its place; and, indeed, the faint nebulous haze with a minute bright centre given here, and on the drawings for the 26th of June 1819, differs totally from the type of drawings given all through the MSS. to represent sun-spots or faculæ. It would therefore be interesting to enquire whether any known comet or meteoric stream lay between us and the Sun on the 26th of May, 1828. It should be remarked that the drawings for May 1828 are on a much larger scale than those for 1819, and that the nebulous spot is both smaller and fainter than in the earlier drawing; it is therefore probable that the comet (if such it be) will turn out to be a very small one compared with that of 1819.

Remarks on Spectroscopic Observations of the Sun, made at the Temple Observatory, Rugby School, in 1871-2-3. By J. M. Wilson, Esq., M.A., and G. M. Seabroke, Esq.

During the last two years and a quarter observations have been made at the Temple Observatory, Rugby, on the positions and forms of the solar prominences, with as much regularity as

* Lat. 52° 25′ 49″ N.; Long. $50^m\ 32^s{\cdot}17$ E. of Paris.

weather permitted. The observations were made from August 1871, to December 1872, with the straight slit, in the usual manner, and since December 1872, with the annular slit, described by one of us, in conjunction with Mr. Lockyer, in the *Proceedings* of the Royal Society in January 1873. This method is found to be satisfactory, and to save much time.

The principal result of these observations is to show, in a very decided manner, that the solar prominences preponderate greatly in the equatorial region of the Sun; that is, they occupy the same region as the spots.

We propose therefore to offer some brief remarks on a theory of prominences and spots, intended primarily to explain their joint occurrence, but incidentally accounting for other phenomena both of spots and prominences. These phenomena are—

(1.) The travelling of spots on the Sun's disk in the direction of his rotation with a velocity increasing as the spots near the equator.

(2.) The rotation of spots.

(3.) The appearance of the penumbra as the spot nears the edge.

(4.) Spectroscopic observations on spots.

(5.) Connection of faculæ and spots.

Our reason for publishing such a speculation is that it suggests further observations, some of which require higher telescopic power, and more leisure, than we have at our command.

Let it be supposed (1) that at some depth below the Sun's surface the pressure is such that substances such as some metals are in a liquid state, though at a temperature far exceeding their boiling point under ordinary pressure. This will be the case unless the temperature of the interior of the Sun is above all their critical temperatures, in which case no pressure would liquify them; and the fact of some liquids or solids existing in the Sun seems probable from a consideration of its density.

In this case, the liquids will on the whole arrange themselves in order of density, the denser being below the lighter.

Such liquids maintain their liquid state solely in virtue of pressure, and if that is diminished they may burst into vapour. The equilibrium therefore must be unstable; a disturbance of pressure will create an outburst, originating at whatever depth liquids exist in this condition, and the outburst will travel in the direction of least resistance, i.e. towards the surface.

This result will be remarkably intensified if (2) there exist two liquids in the Sun so related, that the denser has the lower boiling point, and not capable of freely mixing with each other, like water and oil, or like chloroform and water. The effect of this combination is easily studied by taking a long glass tube, closed at the bottom, and having nearly filled it with water, pouring a few drops of chloroform into the water. If then the water is heated to near its boiling point by a flame held to the side of the tube above the chloroform, and then the chloroform

itself is heated, the water is violently ejected from the tube, the vapour of chloroform being superheated in the boiling water. Such a combination makes a kind of geyser of very sudden and violent action.

On these hypotheses, disturbances of pressure will produce vertical eruptions through the upper layers of the Sun, and throw up the chromosphere, and portions of the photosphere, into jets such as are observed. These jets will tend to be cyclonic, as we and others have observed them to be, when they cover a large area. These substances, which are carried up into the prominences, will of course be detected, as they have been, by the spectroscope. Further, if liquids or solids are carried up, there will be streaks or flashes of continuous spectrum, as seen, we believe, by Zöllner and Secchi.

Whenever there has been such an outburst, the substances must again fall to the Sun, cooled by the expansion. They will fall, and as they fall, they will produce a region of general absorption and of greater selective absorption. When any portion of the descending material is liquid—like the steam of the geyser eruption descending in water drops—the general absorption will be great; and this will be in the centre of the cooler region of descending material. Moreover, the descent of such a liquid on the heated liquids below would tend to cool those liquids, and cause less emission of light. The chloroform, to recur to the experiment above, descends in drops on the boiling water, and is again evaporated, cooling it each time it falls.

The descent from an elevated region, where the ejected materials will have received an impulse in the direction of the Sun's rotation from the atmosphere through which they will have passed, will cause the descending materials to retain some of that velocity, and thus to travel over the Sun's surface in the direction of its rotation. And in such a descending column rotation would spring up and the spot would seem to rotate.

When a spot is viewed vertically the penumbra, the region of cooler gases, will surround the umbra, the region of cooler gases and liquids; but when seen near the edge of the Sun, the umbra will be lost sight of, as lying deeper than the penumbra.

That the penumbra and umbra should have every degree of distinctness from one another, from the perfect blending, as shown in some of the Harvard sketches, to the sharp separation as usually seen with low powers, is quite compatible with this theory.

The bright bridges and the projecting tongues of light over the penumbra and umbra are portions of the photosphere drawn into the vortex of descending vapour. Or they may be sometimes secondary discharges of portions of the chromosphere thrown up in the neighbourhood of the spot. This would seem to have been the case on March 13 of this year. One of us examined the spot at 11 A.M., and reported in our notebook, 'Hydrogen seen over spot. F and C lines reversed at 11 A.M. half across

spot. The spot was then only partly divided by bridge (*a*) in diagram. Bridge approaching us.' The other of us happened to examine the same spot independently at 11.50, and reported, 'Hydrogen lines seen reversed across the whole spot. The dark line C was reversed, finely defined on the red side, and extending beyond the C, and indefinite on the yellow side.'

The faculæ are elevated regions, and regions in general of ascent. Prominences and faculæ have the same general cause, and will co-exist, the difference between them being simply one of intensity and of localisation to a smaller area. The spot is the region of descent corresponding to regions of ascent, and will therefore occupy the same belts of surface as prominences.

If this theory be true, the following consequences ought to follow from it, and, therefore, to be observed :—

(1.) The period of maximum sun-spots ought to be identical with that of maximum prominences. The prominences have scarcely been observed long enough to establish whether this is or is not true.

(2.) There ought to be a diminution of the height of the chromosphere in the period of maximum sun-spots. This, we have some reason to believe, is the case.

(3.) In maximum sun-spot periods, the umbra of spots should be larger relatively to the penumbra than in the periods of minimum sun-spots.

(4.) Prominences ought, on the whole, to lean in the direction opposite to that of the rotation of the Sun. From our position, relatively to the solar equator, we can only see this, if it is the case, in spring and autumn ; and an examination of all our drawings establishes that this is nearly always the case. The exceptions are very decided lateral jets, which appear to slope indifferently in both directions.

(5.) That faculæ should have a proper motion in the opposite direction to that of a spot.

(6.) That a spot should be more frequently bridged from the West, as we see the Sun, than from the East.

(7.) That there ought to be regions, even near the equator, relatively free from spots for long periods of time; for when disturbance has once begun, it will be long continued.

We do not know whether this could be shown from observation.

(8.) The period of spots ought to coincide with that of some assignable cause of disturbance of pressure.

Rugby, 1873, *Nov.* 11.

On the Determination of Time from Sextant Observations.

By William Lassell, Esq.

It is of late but seldom that I have the pleasure of sending to the Society a communication—indeed I have for some time